DIVISION San Diego

MODEL MX-774

REPORT ZM-MX-774-004

DATE 14 August 1947

TITLE

CHARACTERISTICS OF MX-774 TEST VEHICLE FOR PROPOSED USE AS A HIGH ALTITUDE SOUNDING ROCKET.

SUBMITTED UNDER

PREPARED BY K. Bossart
K. J. Bossart

GROUP

REFERENCE

CHECKED BY

APPROVED BY Frank Davis
for C. R. Irvine

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## GENERAL DESCRIPTION

The MX-774 test vehicle is a self launched high altitude rocket of the V-2 type. The power plant consists of four liquid oxygen - alcohol jets fed by a turbo pump. The turbo pump is driven by steam produced by the dissociation of 90% concentration Hydrogen Peroxide passed through a permanganate catalyst.

The airframe is of aluminum alloy construction throughout, except for a tubular steel engine mount. Welded aluminum fuel tanks are of the integral type. Internal pressurization is provided by nitrogen or helium contained in two welded and heat treated steel flasks.

Control for stabilization of the missile in pitch, yaw and roll is derived from two sources namely: (1) Aerodynamic surfaces and (2) direct thrust by means of swiveling of the four rocket motor tubes. Both systems of control are effective within the atmosphere where the highest control moments are required. The direct thrust control from swiveling the rocket tubes takes over during launching when the airspeed is zero or very low and outside the atmosphere.

The motion of both the jets and aerodynamic vanes are controlled by three position gyros and three rate gyros whose signals are electronically mixed and amplified. The electrical signals are translated into mechanical motion by a hydraulic system through the medium of solenoid actuated valves.

The fuel alcohol is used as actuating fluid in this hydraulic system, being energized by the fuel pump it thus obviates the necessity of an auxiliary power source for controls. The vehicle will be equipped with a 40 ft. ribbon type parachute located in the nose section.

This parachute is to be released at the top of the trajectory and is designed to bring the entire rocket down at a rate of descent of approximately 40 ft/sec. This speed of descent is low enough so that the major part of the power plant, gyros and electronic equipment should be retrieved undamaged.

Antennas suitable for tracking and telemetering of data are built into the missile.

Overall dimensions are shown in fig 1 cross hatched areas represent space available for installation of payload.

An additional 3.4 cu. ft. would be available in case no recovery parachute is used.

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TABLE #1

Weight breakdown is as follows:

| | |
|---|---|
| Body Group | 234.0 |
| Fin Group | 104.0 |
| Power Plant Group | 417.0 |
| Fixed Equip. Group | 283.0 |
| Payload | 100.0 |
| Final Weight | 1138.0 |
| Fuel - Alcohol | 1350.0 |
| - Oxygen | 1500.0 |
| - $H_2O_2$ | 65.0 |
| Initial Weight | 4053.0 |

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## PERFORMANCE

Payload of vehicle is plotted against max. altitude that can be attained on graph of fig 2.

These data are based on the assumption of an 8,000 lb thrust at sea level and a specific impulse of 210 sec. Ground tests of the power plant show these figures to be conservative.

It should be noted that as payload - and therefore total gross weight - increases the launching acceleration of the rocket decreases. Launching acceleration for 100 lb payload computes to be 1 g; for 1,400 lb payload this acceleration is reduced to .5 g.

Dotted line in fig. 2 shows the improvement in performance that can be expected when no recovery chute is used.

Still higher altitudes can be reached by increasing the fuel capacity. This would involve a lengthening of the body. The gain in performance that can be achieved in this fashion is illustrated by the table for six alternate versions of the rocket.

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TABLE #2

| | Payload (lbs.) | Length (ft.) | Altitude (1,000 ft) |
|---|---|---|---|
| Present | 100 | 31.6 | 631 |
| Design | 200 | 31.6 | 558 |
| | 300 | 31.6 | 496 |
| Launching | 100 | 33.5 | 688 |
| Acceleration | 200 | 33.1 | 602 |
| 0.75g | 300 | 32.8 | 527 |
| Launching | 100 | 36.2 | 740 |
| Acceleration | 200 | 35.9 | 654 |
| .5g | 300 | 35.5 | 580 |

These data are presented graphically in fig. 2 & 2a

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## HANDLING AND LAUNCHING PROVISIONS

A special transport and hoisting trailer and a portable launching stand similar to that used for the German V-2, have been designed and built for handling the missile during launching.

The trailer is designed to set the missile on the launching table in vertical position. The missile electrical system is connected to a remote control station by means of an umbilical chord. Warm-up of gyros and electronic equipment is accomplished from an external battery. A remote starting switch will pressurize the fuel tanks, start the fuel pumps and ignite the propulsion jets in automatic sequence.

Through the medium of a special release system designed into the launching table, the missile is prevented from taking off until the pressures in all four rocket cylinders are equal.

Within the limits of the inherent characteristics of all rocket fuels, it is the contractor's analysis that the Liquid Oxygen - Alcohol system employed, presents the least hazard to operating personnel and equipment. Furthermore, all high pressure flasks within the missile are proof tested to 125% of maximum operating pressure prior to installation.

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## STATE OF DEVELOPMENT

The 8,000 lb thrust propulsion system has passed acceptance test (including swiveling of the jets).

Airframe design is complete and most parts for an original release of ten missiles have been fabricated and are in stock. Assembly of static firing test missile and first flight missile are well advanced.

All electronic components for one missile are complete and work is progressing on parts for subsequent missiles. A specially designed 22 channel telemetering equipment has been successfully flight tested in a C-46 airplane up to 250 miles range.

A C.W. doppler speed indicater has been developed and flight tested in the C-46 airplane up to 100 miles range. A complete stabilization system (electronic and hydraulic) is being tested adjusted and refined on a flight simulator prior to installation in the missile.

A special static firing test missile is being readied for tests in a specially designed tower equipped with gimbal mountings for the purpose of evaluating the stabilization and propulsion system as an integrated unit prior to free flight testing of the missile.

This installation is so arranged that repeated tests can be accomplished, should adjustments be found necessary.

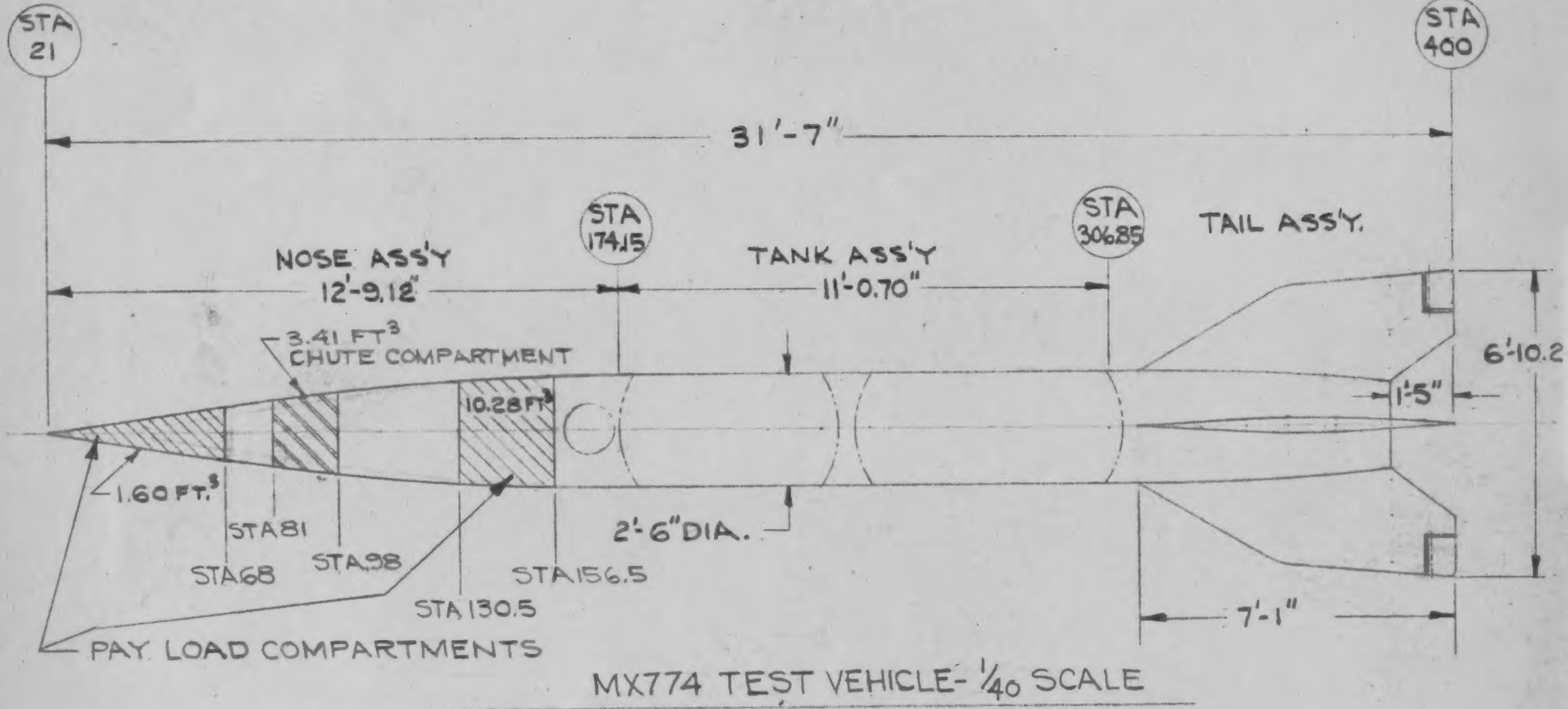
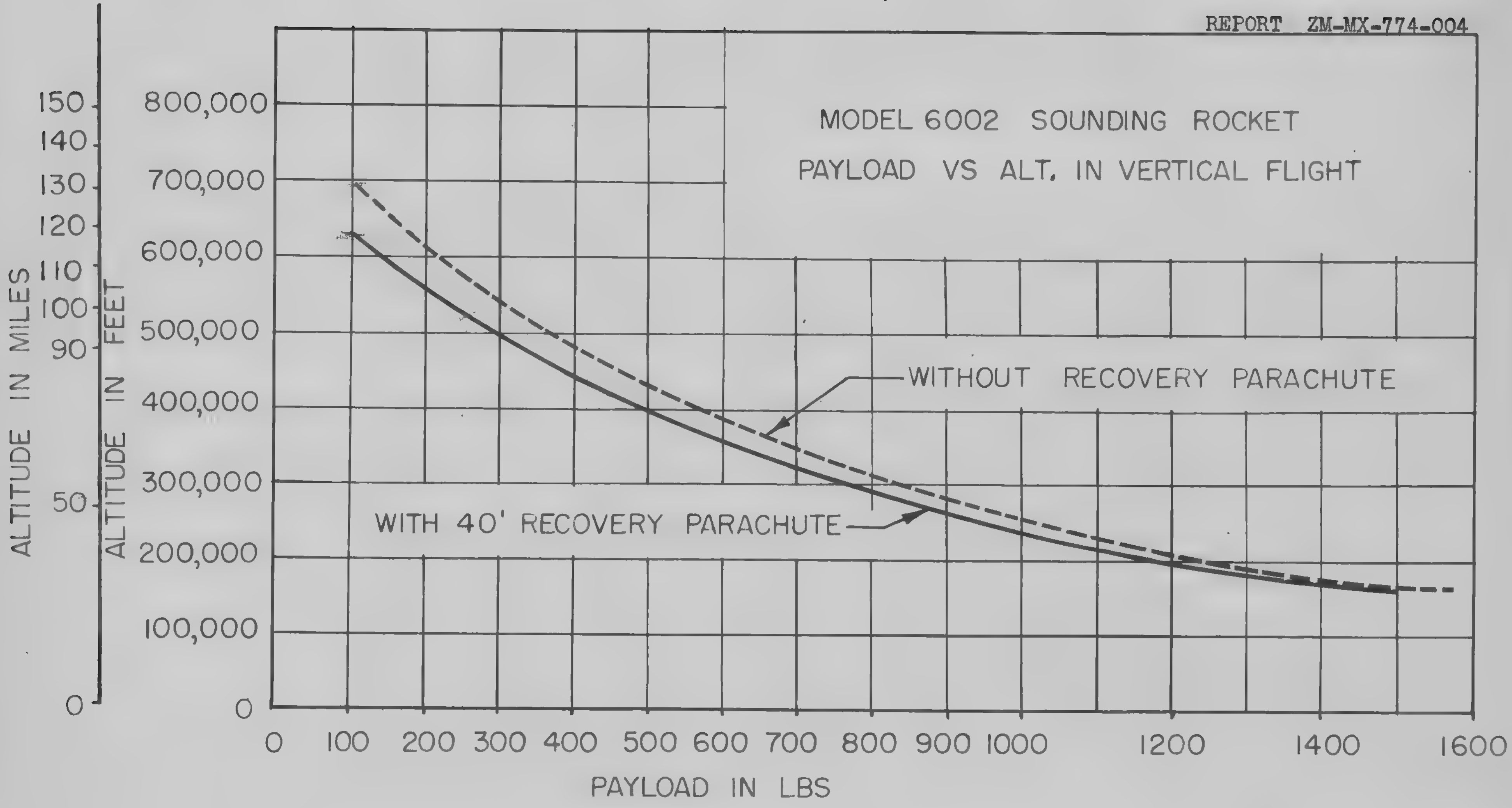



FIG. 1 -- General Arrangement



MODEL 6002 SOUNDING ROCKET
PAYLOAD VS ALT. IN VERTICAL FLIGHT
WITHOUT RECOVERY PARACHUTE
WITH 40' RECOVERY PARACHUTE
ALTITUDE IN MILES
150
140
130
120
110
100
90
50
0
ALTITUDE IN FEET
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
0 100 200 300 400 500 600 700 800 900 1000 1200 1400 1600
PAYLOAD IN LBS


FIG. 2

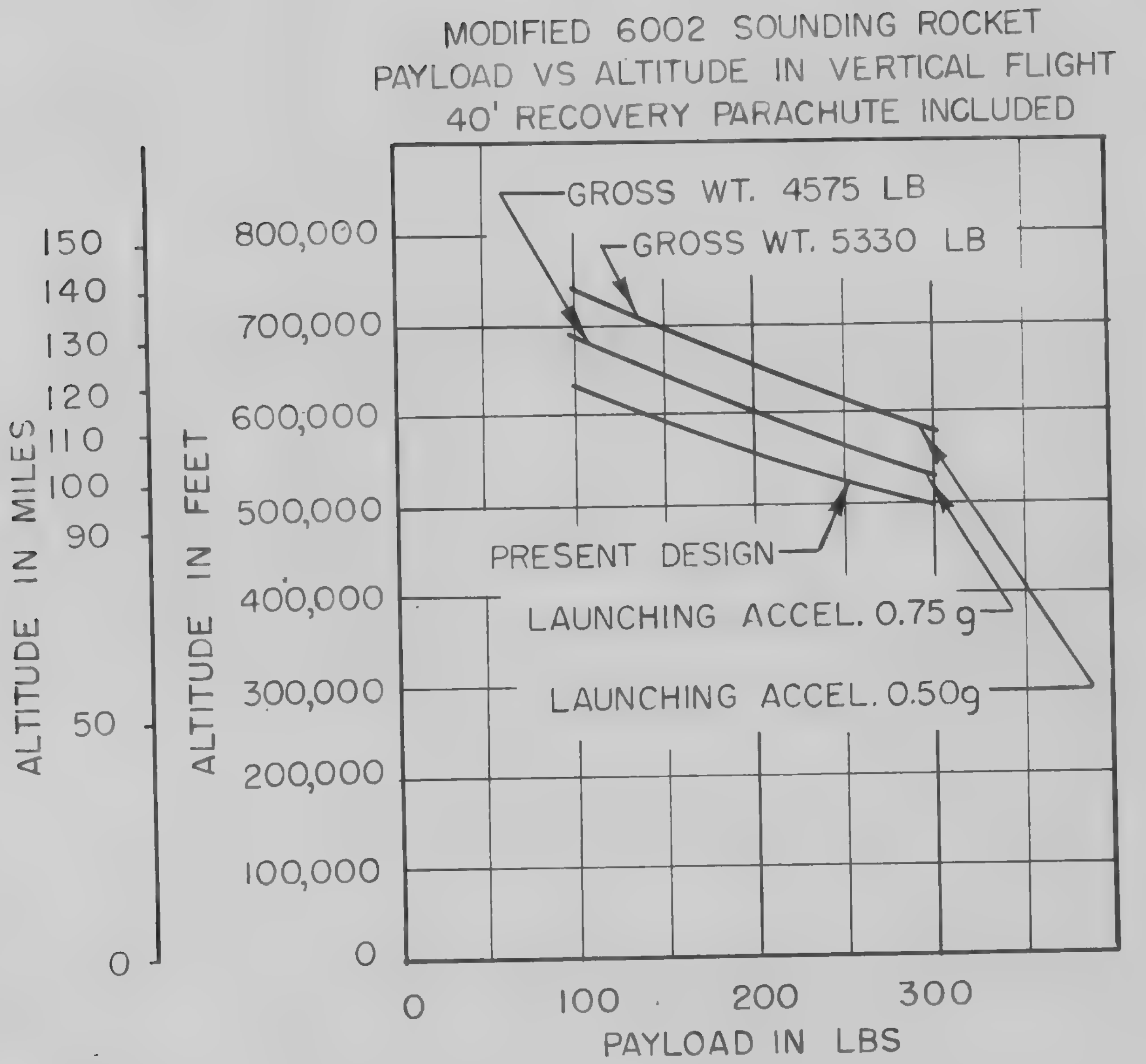
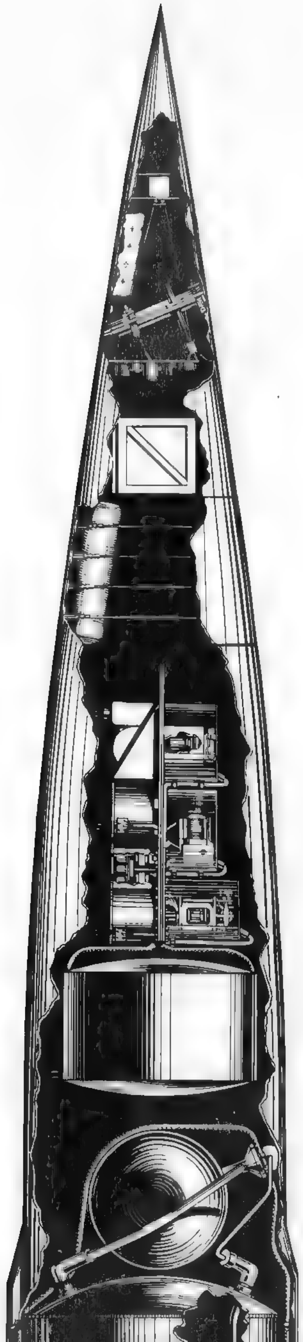

MODIFIED 6002 SOUNDING ROCKET
PAYLOAD VS ALTITUDE IN VERTICAL FLIGHT
40' RECOVERY PARACHUTE INCLUDED
GROSS WT. 4575 LB
GROSS WT. 5330 LB
PRESENT DESIGN
LAUNCHING ACCEL. 0.75 g
LAUNCHING ACCEL. 0.50g
ALTITUDE IN MILES
150
140
130
120
110
100
90
50
0
ALTITUDE IN FEET
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
100
200
300
PAYLOAD IN LBS

FIG. 2a



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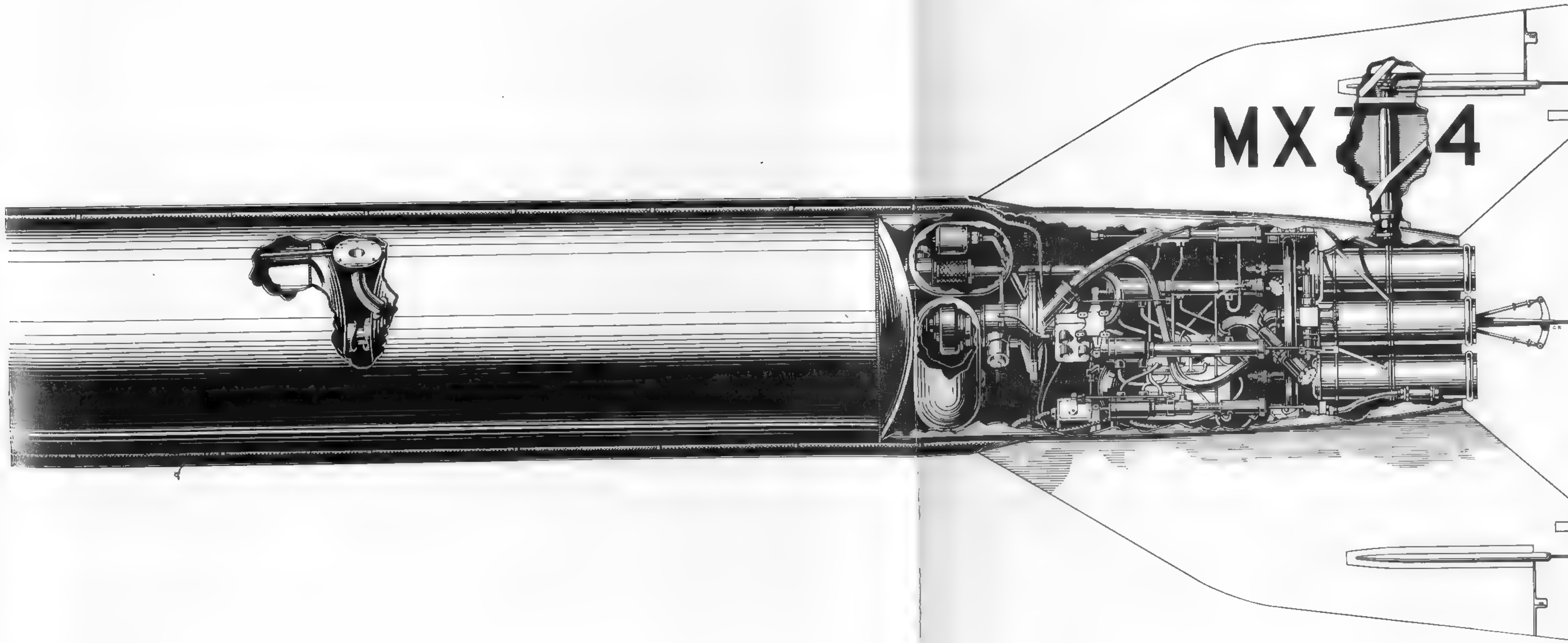


Figure 3

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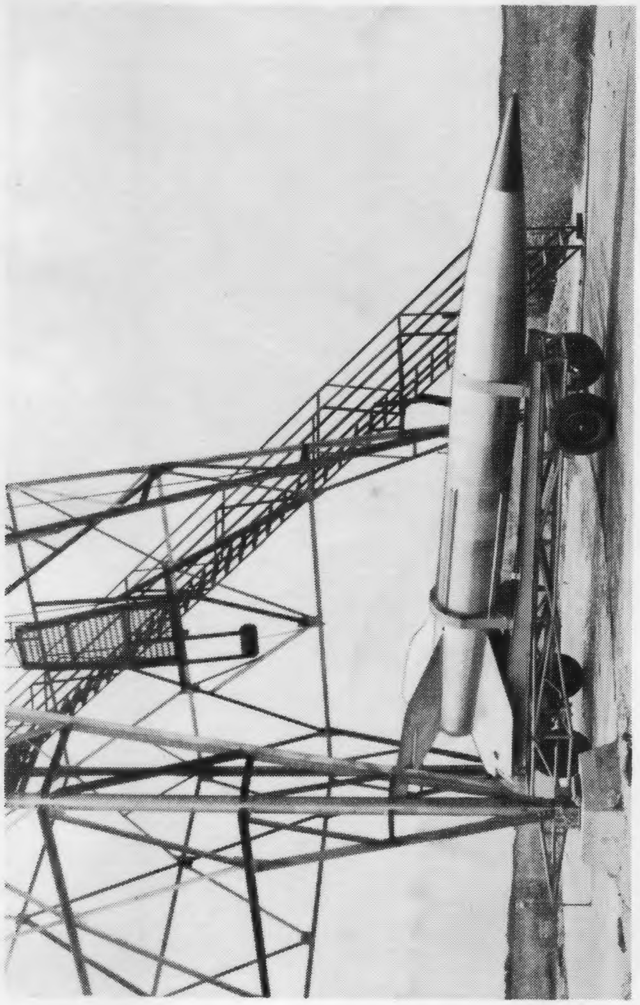

Figure 4

Missile on Transport & Hoisting Trailer

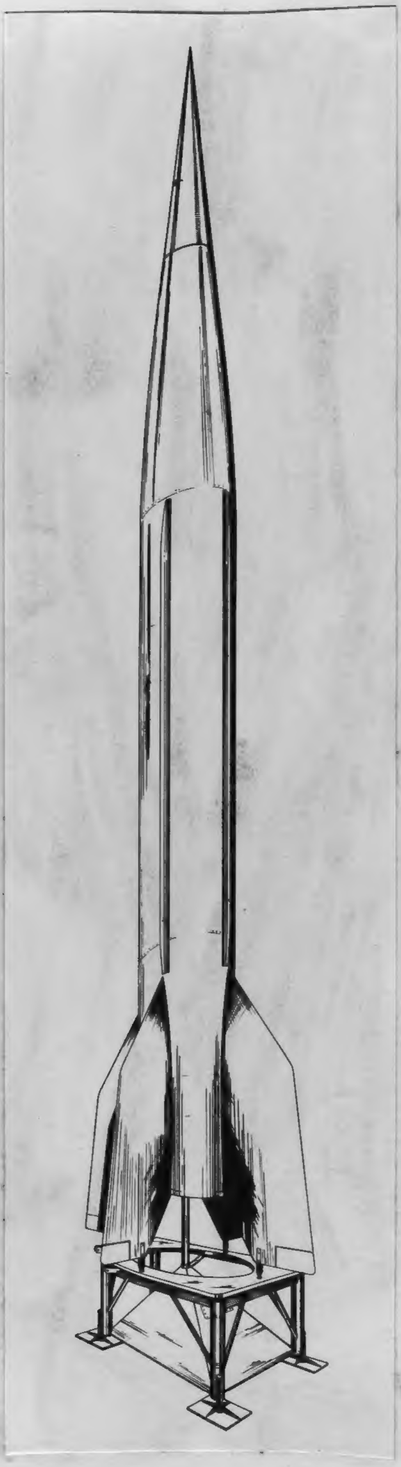

FIG. 5 -- Missile on Launching Table

FIG. 6 -- Missile Mounted in Static Firing Gimbals Test Tower

FIG. 7

Static firing Site at Fort Rosecrans, California